External DrägerService mode with personal computer

Some tests of the external DrägerService mode with personal computer require a separate test set-up including test equipment.

1 Use and system requirements

1.1 Use

The external DrägerService mode with personal computer can be used to read out parameters (e.g. sensors, voltages, errors, or software versions), to trigger all actuators (e.g. mixer, valves, or LEDs), and to perform test routines. To do so, the unit uses a special service software. This special condition is shown on the display of the unit. The DrägerService mode with personal computer does not present any restrictions as to the triggering of actuators which, for safety reasons, have to be followed when using an internal DrägerService mode.

1.2 System requirements

Hardware and software requirements:

RS232 extension (9-pin Sub D socket on 9-pin Sub D connector; length = 3 m, with service coding)	79 01 808
RS232 adapter RxD and TxD transposed (9-pin Sub D socket on 9-pin Sub D connector; length = 0.15 m, with service coding)	79 01 888

Service PC with Windows 95 or NT

- In future, new versions of the service software will not run under DOS or Windows 3.n. However, these restrictions do not apply to version 8.n yet.
- Windows 95 requires at least version 8.n of the service software 79 01 831. In future, use service software 79 11 111.
- If Windows NT is used, it is necessary to disable the screensaver, otherwise the software in the medical device could be damaged while downloading.
- If Windows NT is used, it is necessary to create a DOS partition on the PC (a second operating system). At present, this is only required for BD32.
- The service software for BD32 does not function on IBM laptops.

Service software (7901831, on DORIS CD2)

- Operating system

Service PC with Windows 98, Windows NT, Windows 2000, or Windows XP

- Program

Meditest (DOS) runs in a “DOS“ box in full-screen mode.

(Note: HIT (Windows) is being developed; it will probably be available in August 2003.)

The Meditest (DOS) program does not run on all personal computers, for example, not on personal computers that run under DOS mode and that have a screen resolution higher than 640 x 480. The screen resolution in DOS mode can be changed under the menu item “Extras - Configuration“. Set the screen resolution to 640 x 480.

The Meditest (DOS) program does not always run without problems under Windows 2000. If the program does not run without problems, boot the personal computer from DORIS CD2. This will automatically start the DOS version of the service software which contains all previous DOS programs.

Download software (7901831, on DORIS CD 2)

- Operating system

Service PC with Windows 98, Windows 2000, or Windows XP

- Program

The DOS download runs in a “DOS“ box in full-screen mode.

WIN download (Windows) is being developed; it will probably be available as of October 2002.

The screensaver must be deactivated in order to avoid any errors. Run the laptop at full speed to prevent the medical device software from being damaged should an error occur during the download procedure.

BD32 software (7910397, on DORIS CD 2 or DORIS CD 2 Boot)

- Operating system

Service PC with DOS partition or DOS Boot CD-ROM (DORIS CD 2)

- Program

BD32 runs only in a pure DOS environment.

In fast laptops (> 233 MHz), the BD32 adapter 7901980, hardware revision 2, must be used (silvery housing and two LEDs). (Note: hardware revision 1 (black housing with reset button) only runs in PC < 233 MHz.)

In no DOS partition with DOS operating system is installed, boot the PC from DORIS CD 2. This will automatically start the DOS version of the service software which contains all previous DOS programs.

Details about the hardware requirements and operating systems and their configuration can be found on DORIS CD 2 in the “Service Software“ directory (ServiceLaptopHardwareRequirement.pdf).

1.3 Starting DrägerService mode with personal computer

1 Switch on the EvitaXL.
2 Switch the EvitaXL to “Standby“ mode.
3 Press the “Alarm Reset“ softkey.
4 Press the control knob.
5 Press the “System Setup“ key.
6 Press the “Sound, Day/Night“ key.
7 Read out the set sound volume and write it down for later re-input.
8 Press the “Potentiometer“ key.
9 Use the control knob to set the loudspeaker volume to minimum “1“.
10 Press the control knob.
11 Press the “Sensor Parameter“ key.
12 Using the softkeys, switch on the built-in options “Flow“, “O2“, “CO2“, and “SpO2“.
13 Calibrate the flow sensor.
14 Calibrate the O2 sensor.

Note: Calibrations can also be carried out in PC service mode.

15 Switch off the machine.

If the control unit is faulty, the external DrägerService mode can also be carried with the PC, however only to a certain extent.

16 Connect the RS232 adapter and the RS232 extension cable to the “COM1“ port on the EvitaXL.

17 Connect the RS232 extension cable to the “COM1“ or “COM2“ port on the PC. (Note: this connection must not be interrupted during the procedure.)

18 Switch the PC on.

If the PC is run under DOS on the C drive, enter “Service“ and press the “ENTER“ key.

If the PC is run under Windows, start the “Service Software“.

19 Confirm the “Disclaimer“ window by pressing the “ENTER“ key.

20 Using the cursor keys, select the “EvitaXL“ from the “Meditest“ menu item.

21 Press the “ENTER“ key twice.

22 Confirm the window by pressing the “Y“ key.

23 As soon as the operating menu appears, switch the unit on.

The EvitaXL signals the PC that it is ready for communication.

If the service mode does not run without the control unit, check whether the X24 jumper on the Pneumatic Controller PCB is in position 1-2. This connects the internal CAN bus with a resistance of 121 ohms. The jumper can remain in the unit.

1.4 Starting DrägerService mode with personal computer and modem

The unit can be switched to external DrägerService mode using a PC and an appropriate modem.

2 Menu items in the external DrägerService mode

2.1 Status

The “Status“ menu item has the following sub-menus:

- Baudrate
- Software version
- Logbook
- Error list
- ID options
- Operating hours
- Internal CAN

2.1.1 Baudrate

The baud rate (typically 9600) can be changed in the “Baudrate“ sub-menu. Baud rate adjustment is not yet implemented in the DrägerService software.

2.1.2 Software version

The software version is displayed. It is a 4-digit representation. Software version 2.00, for example, is displayed as “0200“.

2.1.3 Logbook

The logbook (user logbook) can be started during the normal operation of the unit. The user logbook data can be read out, deleted, or saved. Logbook data may only be deleted if the user does not need them any more.

Data can be saved, for example, in order to create statistics.

The user can read out the logbook in normal operation mode.

Read Logbook	Displays entries that cannot be shown in normal operating mode, e.g. date, error number, time, and plain text messages.
Save	“Save“ is a sub-menu of “Read Logbook“. The data can be copied directly to a drive, e.g. drive a: (floppy disk drive). To do so, add the respective drive (e.g. a:) to the file name in the “File“ field. Example: a:\filename.txt. Important: The unit data “Serial number“, “Software version“, “Operating hours“ and, if applicable, other remarks must be entered in the “Remark“ field.
Clear logbook	All entries can be cleared.

2.1.4 Error list

The content of the error list can be read out, saved, or cleared.

Read error list	Displays the error numbers, their first and last occurrence, and the error rate.

Save	“Save“ error list is a sub-menu of “Read DS error list“. The data can be copied directly to a drive, e.g. drive a: (floppy disk drive). To do so, add the respective drive (e.g. a:) to the file name in the “File“ field. Example: a: \ filename.txt. Important: The unit data “Serial number“, “Software version“, “Operating hours“ and, if applicable, other remarks must be entered in the “Remark“ field.
Clear error list	All entries can be cleared.
Operating hours error list	Displays the operating hours of the error list since the last clearing procedure. This information is important for error statistics.

2.1.5 ID options

Read ID	Reads out the ID number (unit ID) of the EvitaXL that is stored in an EEPROM on the CPU 68332 PCB. The ID number is assigned by a random generator during manufacturing of the unit when the time of the day is set for the first time with a new EEPROM. The ID number is a unique number. It is needed to enable software options.

Read options list

Displays enabled options.

Meaning: The left “1“, see example below, means block 1. All subsequent digits represent an option. A “1“ means the option is available; a “0“ means the option is not available.

The following options are currently provided in block 1:

- Option 7 = SpO2 measurement
- Option 8 = CO2 measurement
- Option 9 = DC power pack
- Option 10 = PA ventilation mode and tube compensation

Block	Optional	Optional	Optional	Optional
	0 to 7	8 to 15	16 to 23	24 to 31
Example 1_	10000001_	11100011_	01000000_	00000000

Enable options

In this menu, software options can be enabled with a 10-digit code. This digit code depends on the ID number of the unit (unit ID). A check is carried out after entering the digit code. If the check is positive, the option will be available for use after the next power-on.

Important: Hardware options, such as SpO2 and CO2, can be enabled in the unit using a 4-digit code, see Repair Instructions for details.

Clear options

Do not use.

2.1.6 Operating hours

Displays the operating hours of the EvitaXL. The value is store in an EEPROM on the CPU 68332 PCB.

2.1.7 Internal CAN

Displays the printed circuit boards connected to the CPU 68332 PCB via the internal CAN. Press the “Send“ key to view the connected printed circuit boards.

The printed circuit boards are arranged as follows (from left to right): Graphic Controller 8 PCB, Pneumatic Controller PCB, Communication PCB, and 5 x undefined.

A “0“ means the printed circuit board is not fitted, a “1“ means it is fitted.

For example, 11000000 means the Graphic Controller 8 PCB and the Pneumatic Controller PCB are fitted.

2.2 Pneumatics

2.2.1 Valves

Triggers the valves in the pneumatics. The Pneumatic Controller PCB triggers the valves. The trigger voltage is read back at the switching valves Y1.1 and Y1.4 and read out in the second value. Trigger and feedback value must be identical.

off = switching valve de-energized; on = switching valve triggered

Defaults:	All valves, the blender and the PEEP/PIP valve are off.
Y1.1	O2-AIR changeover valve, off = AIR
Y1.2	O2 measurement calibration valve, on = O2 measurement calibration
Y1.3	Safety valve, on = ventilation, off = safety off activated
Y6.1	Calibration valve for inspiratory pressure sensor S6.1, on = calibration

Y6.2	Calibration valve for expiratory pressure sensor S6.2, on = calibration
Y1.4	Nebulizer valve, off = nebulizer off
X35-X38	Connections (of no importance in the EvitaXL)

The voltages at the control transistors can be measured on the Pneumatic Controller PCB, see Repair Instructions “Electronic Components, Pneumatic Controller PCB“ under Pneumatic Controller PCB components layout. Measurement is carried out with the control transistors between X21/2 (AGND) and the ICs D17 and D18 in each case. The valves must be connected during measurement. A measured voltage of approx. 24 V means the valve is switched off, approx. 0 V means the valve is switched on.

Y1.1	O2/AIR changeover valve	D17/4 (X30)
Y1.2	O2 measurement calibration valve	D18/5 (X39)
Y1.3	Safety valve	D17/6 (X32)
Y6.1	Calibration valve for inspiratory pressure sensor S6.1	D17/7 (X33)
Y6.2	Calibration valve for expiratory pressure sensor S6.2	D17/14 (X34)
Y1.4	Nebulizer valve	D17/5 (X31)
X35	Connection (of no importance in the EvitaXL)	D17/15 (X35)
X36	Connection (of no importance in the EvitaXL)	D17/16 (X36)
X37	Connection (of no importance in the EvitaXL)	D17/17 (X37)
X38	Connection (of no importance in the EvitaXL)	D18/4 (X38)

2.2.2 Mixer

Defaults:	All valves, the blender and the PEEP/PIP valve are off.

Flow/O2 pre-setting:	Setting of a volume and an O2 concentration that can be reached with and adjustable flow.
Volume/O2 pre-setting:	Setting of a constant flow with an adjustable O2 concentration.
Zeroing of blender Y2.1 Y2.2	The HPSV cartridges are zeroed.

2.2.3 PEEP valve

A target value can be set between 0 and 120 mbar as the measuring range of the airway pressure sensors is limited to 140 mbar. The set pressure is the pressure present in the hose system (= shut-off pressure in the expiratory valve), not the pressure present at the outlet of the PEEP/PIP valve!

The current across the PEEP/PIP valve can be measured as a voltage between X15/1 (AGND) and X15/2 on the Pneumatic Controller PCB, and, indirectly at a shunt resistor. The measured value 1 mV corresponds to 1 mA. A current of 500 mA corresponds to a PEEP/PIP valve output pressure of approx. 120 mbar. For checking and calibrating the PEEP/PIP valve, see Repair Instructions “Pneumatic components, testing and calibrating of PEEP/PIP valve“.

Notice: The resulting pressure in the hose system in a no-flow condition is lower than the set target value. As an initial value during ventilation, the ventilation software adds 2 mbar to the desired pressure value in each case.

Corner points for a calibrated PEEP/PIP valve:

Set value = resulting pressure in the hose system	Pressure at the outlet of the PEEP/PIP valve
0 mbar	3 mbar
35 mbar	34 mbar

2.2.4 Sensors

Measured values are displayed in mbar/bar, L/min and vol.% O2.

Airway pressures	Pressure sensor (Pinsp) and pressure sensor (Pexp)
	Two measured values of the 2 airway pressure sensors (insp, exp) are displayed. The airway pressure sensors are read in on the Pneumatic Controller PCB. If a longer period of time has passed since the last calibration of the airway pressure sensors during operation, a calibration can be carried out from the “Calibration“ menu. The following two values are displayed for each sensor: Pressure: Airway pressure sensor value in mbar. Voltage: Halved airway pressure sensor output voltage, read in from the Pneumatic Controller PCB. Displayed in mV. Specification of the airway pressure sensors: Measuring range = 140 mbar Voltage = calibration voltage + sensitivity = 36.5 +/-0.3 mV/mbar Important: The airway pressure sensors are calibrated under “Pneumatic“ --> “Calibration“. The calibration voltage of the airway pressure sensors (zero at ambient pressure) must maintain a target value of 1.74 +/-0.50 V. If this voltage is not maintained, the alarm “Pressure measurement inop“ is generated during operation. The output voltages of the airway pressure sensors “Pinsp“ and “Pexp“ can be measured at the connector X17 on the Pneumatic Controller PCB. The measured voltages correspond to the output voltages of the airway pressure sensors.
	X17/2 Airway pressure sensor (expiration) X17/3 Airway pressure sensor (inspiration)

Airway pressures	Pressure sensor (Pinsp) and pressure sensor (Pexp)	
	X17/4	Pressure sensor (Paux)
	X17/5	AGND

Supply pressures:	Supply pressure sensor (AIR) and supply pressure sensor (O2)	
	Absolute pressure = rel. supply pressure + ambient pressure. The supply pressure sensors are located on the respective HPSV cartridge. The Pneumatic Controller PCB reads in the displayed supply pressures. In order to control the valve, each supply pressure is read in on the respective HPSV Controller PCB. In case of blender problems, see Repair Instructions “Pneumatic components, HPS valve“.	
	Pressure:	Pressure in bar absolute.
	Voltage	Halved sensor output voltage, read in by the Pneumatic Controller PCB. Displayed in mV. Specification of the supply pressure sensors: The measuring range of the supply pressure sensors is 0 to 7 bar absolute. Sensitivity = 1.58 V/bar +/-8 mV/bar Offset voltage = 300 mV +/- 30 mV
	The output voltages of the pressure sensors “PAIR“ and “PO2“ can be measured at the connector X19 on the Pneumatic Controller PCB. The measured voltages correspond to the output voltages of the sensors. The voltage displayed in DrägerService mode is lower by the factor of 2.	
	X19/4	AGND

Supply pressures:	Supply pressure sensor (AIR) and supply pressure sensor (O2)	
	X19/5	Supply pressure sensor (PAIR)
	X19/6	Supply pressure sensor (PO2)

Poes/Pax	no function assigned for the time being
	The “windows“ shown in the display are of no importance.

Pressure measurement

The following “windows“ are opened after starting the menu item:

- Air pressure sensor S2.1
- O2 pressure sensor S2.2
- Pinsp. pressure sensor S6.1
- Pexp pressure sensor S6.2
- POesoph. pressure sensor (Note: The pressure sensor is of no importance in the EvitaXL)
- Paux pressure sensor (Note: The pressure sensor is of no importance in the EvitaXL)

Flow measurement

Measured values of the expiratory flow measurement. The flow sensor is read in on the Pneumatic Controller PCB. If a longer period of time has passed since the last calibration of the flow sensor during operation, a calibration can be carried out from the “Calibration“ menu.

Flow measurement

Note: All values are displayed under BTPS conditions. BTPS: based on 37 degrees centigrade, ambient pressure + inspiratory pressure, 100% rel. humidity. All measured values and set values of the device are based on BTPS.

F-sig. Flow signal	Measured expiratory flow in L/min, converted to BTPS. Corresponds to displayed value. Displayed in mV.
Voltages:	Flow measurement voltage in mV: Voltage of F-INOP: Set voltage greater than or equal to 0.1 V, sensor is probably OK, if F0 and Fsig are OK. With a voltage (F-INOP) less than 0.1 V, the message “Flow measurement inop.“ is generated during normal operation. F0: 4-fold amplified bridge voltage of the flow measurement. Target value in calibrated and no-flow condition = 4.04 V. Fsig: 2-fold amplified bridge voltage of the flow measurement. Target value in calibrated and no-flow condition = 2.02 V. The voltages can be measured at the connector X19 on the Pneumatic Controller PCB: X19/7 AGND, X19/8 Fsig, X19/9 F0, X19/10 Finop
Flow sensor microswitch	Microswitch for position detection of the flow sensor:

Flow measurement		
	closed = flow sensor is in the right-hand operating position.	
	open = flow sensor is not in the operating position, but in the replacement position	

O2 measurement	Measured values of the inspiratory O2 measurement. The output voltage of the O2 sensor is amplified directly at the O2 sensor and read in on the Pneumatic Controller PCB.	
	O2 sensor channel 1	Measured O2 concentration, pressure-compensated. The display range is 0 to 100 vol.%. Important: Measured values between 101 and 106 vol.% are “fixed“ to 100. Values of 107 vol.% or higher are displayed again. Display values above 100 vol.% are possible if the pressure at the O2 sensor is higher than the pressure measured during the airway pressure measurement. This is possible for a short time after the O2 calibration is completed. The alarm “O2 measurement inop.“ is generated when the measured values exceed 106 vol.%.
	O2 sensor channel 1 and O2 sensor channel 2:	Amplified O2 sensor voltage at the output of the Pneumatic Controller PCB. On the Pneumatic Controller PCB the O2 sensor voltage is read in with two A/D channels and compared. A deviation of 17 LSB or 25 mV is allowed between the two values. If the deviation is higher, the A/D converter on the Pneumatic Controller is faulty.
	Important: Amplified O2 sensor voltage during operation and calibration to 100 vol.% O2.	
	Permissible range: 1.257 to 5.644 V	
	Voltage too low: sensor is spent	

Voltage too high: O2 measurement is faulty (O2 amplifier or Pneumatic Controller PCB). The voltages of the O2 amplifier and the two supply voltages to the O2 amplifier can be measured at the connector X19 on the Pneumatic Controller:	
X19/1	Amplified O2 sensor voltage of the O2 amplifier corresponds to the displayed voltage channel 1/2.
X19/2	-15 V supply voltage (O2 amplifier)
X19/3	+15 V supply voltage (O2 amplifier)
X19/4	AGND

2.2.5 Voltages

Operating voltages	Display of the Pneumatic Controller PCB reference voltages. The Pneumatic Controller PCB generates and reads in the reference voltages. An alarm is generated if there is a deviation. Target values: Uref 5V = 4900 to 5100 (displayed in mV) ADCref = 2900 to 3100 (displayed in mV) DACref = 2900 to 3100 (displayed in mV) The voltage “Uref 5V“ can be measured as double voltage (+10 V-A) at the connector X3 on the Pneumatic Controller PCB. All other analog supply voltages can also be measured at the connector X3:
X3/1	+5 V - A
X3/2	-5 V - A
X3/3	-15 V - A

	X3/4 +15 V - C X3/5 +15 V - A X3/6 +10 V - A X3/7 AGND The following supply voltages can be measured at the connectors X11 and X21 on the Pneumatic Controller PCB: X21/1 +24 V - A X21/2 AGND X11/1 DGND X11/2 free X11/3 +5 V
Fan voltage	The current across the fan (the fan is located on the bottom right of the pneumatic assembly) is monitored on the Pneumatic Controller PCB. During operation the voltage must show fluctuations greater than 50 mV. Minimum and maximum of voltage are measured for 60 seconds in each case. If the difference is less than 50 mV, it is assumed that the fan does not rotate. Fan not connected = 0.0 V Fan is short-circuited = greater than 2900 mV
DAC flow measurement	Pre-setting of the decimal D/A converter value for calibration of the flow sensor on the Pneumatic Controller PCB. The target value range is 2200 to 3200. The target value range should make it possible to set the flow measurement sensor voltages, see “Sensors“, to the calibration values at a zero flow.

2.2.6 Calibrations

The sensors (pressure, flow, O2, and PEEP/PIP valve) can be calibrated in the following tests. The status of a calibration can be checked in the pull-down “Submenu“ in the display window.

Insp. and exp. pressure sensors	Zeroing of airway pressure sensors S6.1 and S6.2
Oes. pressure sensor	Zeroing of POesoph pressure sensor (Note: The pressure sensor is of no importance in the EvitaXL).
Flow sensor	Calibration of the flow sensor Important: There must be no flow through the flow sensor during calibration of the flow sensor. This must be ensured by the user of the DrägerService mode.
O2 sensor	O2 sensor calibration Important: O2 supply must be connected.
PEEP/PIP valve	PEEP/PIP valve calibration Important: For test set-up, see Repair Instructions “Pneumatic components, PEEP/PIP valve“. During calibration the device and the PEEP/PIP valve must be in a horizontal operating position as the function of the PEEP/PIP valve depends on the fitting position. Switch the safety valve Y1.3 on before calibrating the PEEP/PIP valve. The criterion for a positive calibration is the flow impulse from the blender, therefore do not connect a hose to the inspiratory socket. Calibration OK: Flow impulse 0.2 seconds Calibration faulty: Flow impulse 1 second

	Possible errors: - no pressure supply connected - safety valve Y1.3 is not switched on - Incorrect or leaky test set-up, see Repair Instructions “Pneumatic components, PEEP/PIP valve“. - The expiratory airway pressure measurement is faulty. The measured value can be read in DrägerService mode, see “Airway pressure measurement“. The target value should toggle between 3 mbar and 34 mbar. - The mechanical zero of the PEEP/PIP valve is faulty, see Repair Instructions “Pneumatic components, PEEP/PIP valve“. - The current source on the Pneumatic Controller PCB is faulty, see Repair Instructions “Pneumatic components, PEEP/PIP valve“.	
Reset PEEP/PIP valve	PEEP/PIP valve calibration basic setting Note: Reset PEEP/PIP values to basic settings.	
Reading calibration data	Displays calibration values of the O2 measurement, expiratory flow measurement, inspiratory and expiratory airway pressure measurement, and PEEP/PIP valve:	
	O2 sensor	Calibration voltage during calibration to 100 vol.% O2. Target value = 1257 to 5644 mV
	Flow sensor	DAC set value during calibration in no-flow condition. Target value = 2200 to 3200 decimal

	Pinsp pressure sensor S6.1	Calibration voltage at ambient pressure. Target value = 1740 +/-500 mV
	Pexp pressure sensor S6.2	
	PEEP/PIP Gain	Displays calibration values for gain and offset.
	PEEP/PIP Offset	

2.2.7 CPU

This test is used to check the RAM area and the EEPROM on the Pneumatic Controller PCB.

RAM test	Output OK or error, the last successfully tested RAM address is also displayed.
ROM test	Is always OK if DrägerService mode is functional.
EEPROM test	Output OK or error. The EEPROM holds the calibration data of the PEEP/PIP valve.

2.3 Electronics

The “Electronics“ menu item has the following sub-menus:

- Voltages
- Status of power pack
- Sensors
- CO2
- SpO2
- Horn
- Loudspeaker
- GoldCap
- ILV
- CPU
- Pediatric flow

2.3.1 Voltages

GoldCap	Display of the GoldCap capacitor voltage. The GoldCap capacitor powers the standby horn. The GoldCap capacitor including charging circuit and measurement function are located on the CO2 Carrier PCB. Displays the voltage and the decimal value of the A/D conversion. Target value = 8000 to 11000 (in mV)

5V / 12V / 15V / -15V /24V	Power pack supply voltages, measured on the CO2 Carrier PCB. Displays the voltages and the decimal values of the A/D conversion. No device error messages are generated with the following values: 5 V = 4500 to 5500 (in mV) 12 V = 9600 to 14400 (in mV) 15 V = 14000 to 18000 (in mV) -15 V = -12000 to -18000 (in mV) 24 V = 19200 to 28800 (in mV)
S8 reference	Displays the A/D converter reference voltage “AD1“. Displays the voltage and the decimal value of the A/D conversion. The value is monitored indirectly. The voltage is OK if the 10 V are within tolerance. Target value approx. 2500 (in mV)
Ext. battery	Displays the voltage of the connected external DC voltage supply (DC module). Displays the voltage and the decimal value of the A/D conversion.
AD converter S13 (10 V ref.)	10V reference voltage, generated from the 15V supply voltage on the CO2 Carrier PCB. A/D conversion takes also place on the CO2 Carrier PCB. Displays the voltage and the decimal value of the A/D conversion. An error message is generated if there is a deviation greater than 4%. Target value = 965 to 1035 (in mV)

S16 reference	Displays the A/D converter reference voltage “AD2“. Displays the voltage and the decimal value of the A/D conversion. The value is monitored indirectly. The voltage is OK if the 10 V are within tolerance. Target value approx. 2500 (in mV)

2.3.2 Status of power pack

Displays the status of the power pack.

Status of internal battery	Displays the charging status of the internal battery (DC module). The CPU 68332 read the digital signal of the DC module. Charging status display: charged: Internal batteries have reached the maximum charging voltage. undefined: Internal batteries have not yet reached the maximum charging capacity, are not connected or are faulty.
External battery status	Displays the charging status of the external battery. The CPU 68332 read the digital signal of the DC module. Charging status display: charged: External batteries have reached the maximum charging voltage. undefined: External batteries have not yet reached the maximum charging capacity, are not connected or are faulty. Important: The voltage can be read under “Voltages“. Provided is/are 1 or 2 series-connected gel batteries with a nominal voltage of 12 V. Gel batteries are charged at a charging voltage of 13.8 V.

Internal battery in use, external battery in use	While the internal or external batteries are in use, the CPU 68332 PCB reads a digital signal from the DC module. off: No power supply from the internal or external batteries. on: Power supply from the internal or external batteries. Important: During DC operation only one signal may be “on“. All power pack status signals can be measured at the connector X2 on the CPU 68332 PCB. When an extender board is used, it is possible to use any slot on the motherboard, above or below, for X2. All signals are low-active: X2/26b Internal battery X2/27b External battery X2/28b AC mains supply operation
AD converter S3 (mains off)	Displays the voltage at the mains switch auxiliary contact. The voltage is important for detection of a mains power failure. The mains switch is in the power pack. The voltage is evaluated on the CO2 Carrier PCB. Displays the voltage and the decimal value of the A/D conversion. Mains switch on, less than 164 decimals (100 mV) Mains switch off, greater than 512 decimals (312 mV)

The ohmic resistance of the mains switch can be checked as follows:

- Switch off the device.
- Remove the CO2 Carrier PCB.
- Use an ohmmeter to measure the resistance at the connector X1 on the CPU 68332 PCB:
- Between X1/11c (mains center) and X1/10c (mains on): Device off --> high resistance, device on --> low resistance.
- Between X1/11c (mains center) and X1/15c (mains off): Device off --> low resistance, device on --> high resistance.

Possible errors:

- If both values are high-resistance, it is possible that the mains switch auxiliary contacts in the power pack are not connected. The connector on the board in the AC power might have been disconnected from the mains switch auxiliary contact when retrofitting the DC module.
- If both values are low-resistance, the mains switch is faulty or there is a short-circuit.
- If both values are inverted, the connector to the mains switch auxiliary contact on the board in the AC power pack has been connected incorrectly (incorrect polarity).
- Assemble the machine ready for use.

2.3.3 Sensors

Device temperature	The device internal temperature is measured on the CO2 Carrier PCB. The temperature is displayed in degrees centigrade and voltage. Permissible maximum temperature limit is 65 degrees centigrade. If the temperature exceeds 65 degrees centigrade, the message “Fan malfunction!“ will be generated. (The alarm is cancelled at 60 degrees centigrade). If the temperature exceeds 70 degrees centigrade, the alarm “Fan failure!!!“ will be generated. (The alarm is cancelled at 65 degrees centigrade). If the device internal temperature is too high, check the fan in the power pack.
Airway temperature	The airway temperature of the AWT sensor is measured on the CO2 Carrier PCB. The temperature is displayed in degrees centigrade and voltage.
Inspiratory pressure	Second channel of the inspiratory pressure sensor. The inspiratory pressure sensor is located in the pneumatics. The Pneumatic Controller PCB (first channel) and the CO2 Carrier PCB read in the value of the inspiratory pressure sensor. Displayed in mbar and voltage.
Ambient pressure	The currently air atmospheric pressure measured in the device. The atmospheric pressure sensor including A/D conversion are located on the CO2 Carrier PCB. Atmospheric pressure is displayed in mbar and voltage. The permissible measuring range is 600 mbar to 1100 mbar.

2.3.4 CO2

RS232 test	Test of the RS232 interface for CO2 measurement on the CO2 Carrier PCB. This test can be used on a CO2 module that does not respond to service commands in order to find out whether the fault lies in a faulty RS232 interface or in a faulty CO2 module. Preparation for the test: - Switch the device off, leave the PC in the service program. - Remove the CO2 Carrier PCB. - On the CO2 Carrier PCB, move the jumper on connector X14 from position 1-2 (operation) to position 2-3 (test). - Insert the CO2 Carrier into the second slot from top in the electronic assembly. - Switch the device on. - Measure the supply voltage to the CO2 module on the CO2 Carrier PCB. The CO2 module is connected to X9. X9/1 = GND-Iso-CO2, X9/5 = +5 V-Iso-CO2. Important: The voltage is generated from the 5V supply voltage of the power pack on the Power PCB of the CO2 measurement. - Carry out the RS232 test. ok: The CO2 module is faulty. Possible errors: - Optocoupler for CO2 measurement on the CO2 Carrier PCB is faulty. - RS232 interface control on the CPU 68332 PCB is faulty.

	If a faulty was found in the previous test, carry out the following RS232 interface test for the CO2 measurement on the CPU 68332 PCB: - Switch the device off, leave the PC in the service program. - Remove the CO2 Carrier PCB. - On the CPU 68332, create a short circuit at the connector X2 between 28a and 29a. X2 is the connector to the motherboard that is closer to the power pack. When an extender board is used, it is possible to use any slot on the motherboard, above or below, for X2. If no extender board is available, it is possible to create a temporary soldering bridge on the CPU 68332 PCB. - Switch the device on. - Carry out the RS232 test. ok: The optocoupler on the CO2 Carrier PCB is faulty because the CPU 68332 PCB is OK. Error: The CPU 68332 PCB is faulty. Important: After completing the test, switch the device off, set the jumper on the CO2 Carrier PCB to its original position, and reassemble the device ready for use. If a soldering bridge was created on the CPU 68332 PCB, remove it.
Temperature	Displays the temperature of the detector and window temperature in the CO2 sensor. Approx. 43 degrees centigrade are reached after 3 minutes in each case. The temperatures may vary between 40 degrees centigrade and 50 degrees centigrade, depending on the operating conditions.
Vendor ID	Displays the type of board of the Signal Processor PCB of the CO2 measurement on the CO2 Carrier PCB.

Software revision	Displays the software version on the Signal Processor PCB, e.g. “68 70 277 1.1“ for Dräger software version 1.1.
Sensor serial no.	Displays the serial number of the CO2 sensor.
Sensor revision	Displays the part number and the revision status of the CO2 sensor.
Calibration date	Date of the CO2 sensor factory calibration.
Status	CO2 measurement status; (Note: Data only relevant to the software development)

2.3.5 SpO2

RS232 test	Test of the “RS232 interface“ for SpO2 measurement on the CO2 Carrier PCB. This test can be used on a SpO2 module that does not respond to service commands in order to find out whether the fault lies in a faulty RS232 interface or in a faulty SpO2 module. Preparation for the test: - Switch the device off, leave the PC in the service program. - Remove the CO2 Carrier PCB. - On the CO2 Carrier PCB, move the jumper on connector X15 from position 1-2 (operation) to position 2-3 (test). - Insert the CO2 Carrier into the second slot from top in the electronic assembly. - Switch the device on.

- Measure the supply voltage to the SpO2 module on the CO2 Carrier PCB. X5/1 = GND-Iso, X5/2 = +5 V, X5/3 = +15 V, X5/4 = -15 V

Important: The voltages are generated from the 24V supply voltage from the power pack on the CO2 Carrier PCB.

- Carry out the “RS232“ test.

ok: The SpO2 module is faulty.

Possible errors:

- Optocoupler for SpO2 measurement on the CO2 Carrier PCB is faulty.
- RS232 interface control on the CPU 68332 PCB is faulty.

If a faulty was found in the previous test, carry out the following RS232 interface test for the SpO2 measurement on the CPU 68332 PCB:

- Switch the device off, leave the PC in the service program.
- Remove the CO2 Carrier PCB.
- On the CPU 68332, create a short circuit at the connector X2 between 27c and 28c. (Note: X2 is the connector to the motherboard that is closer to the power pack.)
- Switch the device on.
- Carry out the “RS232“ test.

ok: The optocoupler on the CO2 Carrier PCB is faulty because the CPU 68332 PCB is OK.

	Error: The CPU 68332 PCB is faulty. **Important: After completing the test, switch the device off, set the jumper on the CO2 Carrier PCB to its original position, and reassemble the device ready for use.**
Software revision	Displays the version of the SpO2 PCB.
SpO2 measured values	Displays the values of the SpO2 measurement. Valid values are available if the optional feature has been fitted and enabled, and if the SpO2 measurement has been switched on. Note: The device does not display the value of the bargraph during operation.

2.3.6 Horn

Horn	The horn (standby horn) is located on the CO2 Carrier PCB. The horn is actuated by the 68332 CPU PCB. GoldCap capacitors on the CO2 Carrier PCB supply the operating voltage to the horn. The voltage of the GoldCap capacitors can be read out from the “Electronics“ --> “Voltages“ menu. The horn can be switched on and off. The value of the horn current can be read out. Possible error sources if the horn cannot be switched on: - The mains switch is faulty; for testing, see “Status of the power pack“. The GoldCap voltage must be present, see “Voltages“.

Checking the horn without the suppression signals from the CPU 68332 PCB:

- Switch off the device.
- Remove the CPU 68332 PCB.
- Switch the device on.

The horn should sound. If not, and if the previous two steps were OK, then the CO2 Carrier is most probably faulty.

- Assemble the device ready for use.

Possible error sources if the horn cannot be switched off:

Checking the horn suppression signals on the CPU 68332 PCB without the CO2 Carrier PCB.

- Switch off the device.
- Remove the CO2 Carrier PCB.
- Measure the voltage on the CPU 68332 PCB between DGND (e.g. at X11/3 next to the battery) and X2/31c.
- Switch the device on.
- Switch the horn on from the menu.

The DC voltage should be constant logic “High“ (5 V) or “Low“ (0 V).

- Switch the horn off from the menu.

A square-wave voltage changes between “High“ and “Low“ every 8 ms. The square-wave voltage can be measured with a DC or AC voltmeter. The voltage should be approx. 2.5 V. If the square-wave voltage is present, then the CO2 Carrier PCB is most probably faulty.

- Assemble the device ready for use.

AD converter S2 (horn current)	The current across the standby horn can be measured on the CO2 Carrier PCB. The voltage is indicated by the shunt resistance and the decimal value of the A/D conversion.	
	Horn detected	greater than or equal to 30 decimals (0.018 V)
	Horn off	less than 30 decimals

2.3.7 Loudspeaker

When sending a test tone, the volume of which depends on the setting, the system should be able to detect this test tone. A detected current across the loudspeaker is displayed for another 10 seconds.

The loudspeaker is located in the control unit. The CPU 68332 PCB controls the loudspeaker. The Graphic Controller 8 PCB monitors the loudspeaker by carrying out a current measurement. The ohmic resistance of the loudspeaker can be checked, see error message 02.71.001.

2.3.8 GoldCap

The test GoldCap is started after pressing the “send“ key.

GoldCap	Display of the GoldCap capacitor values. The GoldCap capacitor powers the standby horn. The GoldCap capacitor including charging circuit and measurement function are located on the CO2 Carrier PCB. The voltage and the decimal value of the A/D conversion are displayed in the “AD converter S1 (GoldCap)“ window. Target value = 8000 to 11000 (in mV)

Result of the GoldCap test	The test shows only the last result because the GoldCap test takes more than 10 minutes.

2.3.9 ILV interface

For testing, connect pin 4 (ILVout1) with pin 8 (ILVin1) and pin 6 (ILVout2) with pin 1 (ILVin2), respectively, at the ILV interface.

The ILV interface is located on the CPU 68332 PCB. The ILV interface has two digital outputs and inputs for synchronization of two ventilators (independent lung ventilation).

ILV interface test	The test takes about 2 seconds. ok/ok: The ILV interface is OK. Error: The ILV interface on the CPU 68332 PCB is faulty.

2.3.10 CPU

Testing of the RAM, ROM, and EEPROM areas on the CPU 68332 PCB.

RAM test	Displays “OK“ or “error“. The most recent, successfully tested RAM address is also shown.
ROM test	Is always OK if DrägerService mode is functional.
EEPROM test	Displays “OK“ or “error“.

Note regarding the “Data loss“ alarm:

A data loss has occurred in the EEPROM if after power-on, for example, the enabled optional features or the operating hours are no longer available. A data loss in the RAM suggests a spent battery on the CPU 68332 PCB. After a data loss, the device tries to restore the data. If it is successful, the red “Data loss“ alarm disappears from the display. If the alarm does not reoccur upon the new power-on, the device is OK.

2.3.11 Pediatric flow

The “Pediatric flow“ menu item has the following sub-menus:

- Pediatric flow measurement
- Ped. shadow flow
- Ped. flow calibration
- Ped. status
- ADC ped. flow
- DAC1 ped. flow
- DAC2 ped. flow

2.4 Front

The front is a removable control unit. The “Front“ test comprises the following test steps:

- Keys
- LEDs
- 7-segment
- Rotary knob
- Touchscreen
- Display
- Loudspeaker
- CPU

2.4.1 Keys

The status of the key is displayed in the first line of the “Keypad test“ window.

The Graphic Controller 8 PCB scans the keys.

Meaning: 0 = key is not pressed; 1 = key is pressed

Possible errors:	
One key is faulty:	Keypad is faulty.
Several keys are faulty:	If several keys are faulty, the most probable error source is the Graphic Controller 8 PCB.

2.4.2 LEDs

This test allows to switch all LEDs on or off. Individual LEDs can be triggered with the “LEDs“ test.

The “LEDs“ menu item has the following submenus:

- all LEDs on
- all LEDs off
- LEDs

The Graphic Controller 8 PCB actuates the LEDs on the keypad.

all LEDs on	All LEDs come on.
all LEDs off	All LEDs should go off.
LEDs	Individual LEDs can be actuated with the cursor or the mouse only in the LED 1 ... 8 line.

The LEDs are arranged as follows:	
No.	LED
1	Start/standby
2	System setup
3	Sensor parameters
4	(option)
5	Ventilator settings
6	Alarm limits
7	Alarm silence

2.4.3 2.4.3 7-segment

The “7-segment“ test item is of no importance in the EvitaXL.

2.4.4 Rotary knob

The following changes are measured and displayed within one second. (Note: The rotation impulses (0 to 128) are displayed as of 2 positions.)

The Graphics Controller 8 PCB reads out the data from the rotary knob.

right	Direction of rotation (right)
left	Direction of rotation (left)
Switch position “open“	Rotary knob is not pressed
Switch position “closed“	Rotary knob is pressed

2.4.5 Touchscreen

The following tests can be carried out:

The touchscreen has its own microprocessor system. This microprocessor system communicates with the Graphic Controller 8 PCB through the RS232 interface.

- Column test
- Line test
- RS232 test
- Error codes
- Firmware version
- Beam error column
- Beam error lines
- BOOT status
- Software version
- Hardware version
- Hardware version

Column test	To activate the test, slowly move a finger over the touchscreen: The touchscreen blanks the display where the finger has touched the touchscreen. Note: The display is bright again as soon as the test is deactivated.

Line test	To activate the test, slowly move a finger over the touchscreen: The touchscreen blanks the display where the finger has touched the touchscreen. Note: The display is bright again as soon as the test is deactivated.
RS232 test	This test is of no importance in the EvitaXL.
Error codes	This test is of no importance in the EvitaXL.
Firmware version	This test is of no importance in the EvitaXL.
Beam error column	This test is of no importance in the EvitaXL.
Beam error lines	This test is of no importance in the EvitaXL.
BOOT status	This test is of no importance in the EvitaXL.
Software version	This test is of no importance in the EvitaXL.
Hardware version	This test is of no importance in the EvitaXL.
Hardware version	This test is of no importance in the EvitaXL.

2.4.6 Display

If the display no longer reacts to the following commands, but the rest of the front is still functional and the backlighting is still visible, then the display or the Graphic Controller 8 PCB is faulty. A test cannot be carried out with simple means.

The Graphic Controller 8 PCB controls the display.

Test pattern	white grid = the display is white with a small red frame black grid = the display is white with a small red frame white area = the display is white black area = the display is black red area = the display is red Note: The text “Service Mode“ remains visible in a white rectangle in all test patterns.

2.4.7 Manufacturer

The “Manufacturer“ test is not relevant.

2.4.8 Loudspeaker

For “Loudspeaker“ test, see test step 2.3.7.

For “Horn“ test, see test step 2.3.6.

2.4.9 CPU

The RAM area on the Graphic Controller 8 PCB is tested.

RAM test	“OK“ or “error“ is displayed, the last successfully tested RAM address is also displayed.
ROM test	Is always OK if communication with the Graphic Controller 8 PCB is possible.

2.5 Communication

The “Communication“ menu has the following submenus:

- Analog output 1
- Analog output 2
- RS232 test
- CPU
- External CAN

2.5.1 Analog output 1

Testing of the target value between 0 and 4095 mV.

2.5.2 Analog output 2

Testing of the target value between 0 and 4095 mV.

2.5.3 RS232 test

Testing of the external RS232 interfaces. Pins 2 and 3 on the RS232 interfaces COM1 and COM2, respectively, are short-circuited and a LOOP test is carried out.

2.5.4 CPU

Testing of the RAM area and the ROM area of the Communication PCB.

RAM test	“OK“ or “error“ is displayed, the last successfully tested RAM address is also displayed.
ROM test	Is always “ok“ if communication with the Communication PCB is possible.

2.5.5 External CAN

The external CAN test is of no importance in the EvitaXL.

2.6 IFCO

The IFCO menu item has the following submenus:

- Central alarm
- LEDs remote pad
- Keys remote pad
- IFCO ambient pressure

2.6.1 Central alarm

Testing of the central alarm. The text “ok“ appears as soon as the test is activated and an IFCO Carrier PCB is available in the device. The text “error“ appears if no IFCO Carrier PCB is available in the device.

2.6.2 LEDs remote pad

This test allows to switch all remote pad LEDs on or off.

2.6.3 Keys remote pad

The status of the key is displayed in the “Keys remote pad“ window with one switch position. The top key on the remote pad means the top line in the “Keys remote pad“ window.

(Meaning of the switch position: open = the key is not pressed, closed = the key is pressed)

2.6.4 IFCO ambient pressure

The “IFCO ambient pressure“ window displays the following values:

Pressure	Ambient pressure sensor value in mbar.
Voltage	Voltage value in mV.